Unit 11

Organic Chemistry

Long Answer Questions

Q.1 Explain the types of formulae of organic compounds.

Ans. There are four types of formulae of organic compounds:

(i) Molecular formula
(ii) Structural formula
(iii) Condensed formula
(iv) Dot and cross formula

(i) Molecular Formula

The formula which represents the actual number of atoms in one molecule of the organic compound is called the molecular formula. For example molecular formula of butane is C_4H_{10}. It shows:

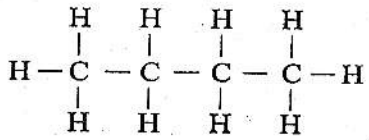
(a) Butane is made up of carbon and hydrogen atoms.
(b) Each molecule of butane consists of 4 carbon atoms and 10 hydrogen atoms.

(ii) Structural Formula

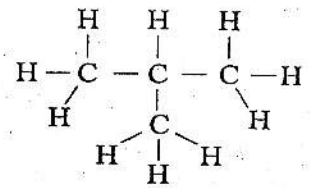
Structural formula of a compound represents the exact arrangement of the different atoms of various elements present in a molecule of a substance.

In a structural formula, single bond is represented by a single line (—), a double bond by two lines (=) and a triple bond by three lines (≡) between the bonded atoms.

Organic compounds may have same molecular formulae but different structural formulae, e.g., structural formulae of butane C_4H_{10} are:



n-Butane



isobutane

(iii) Condensed Formula

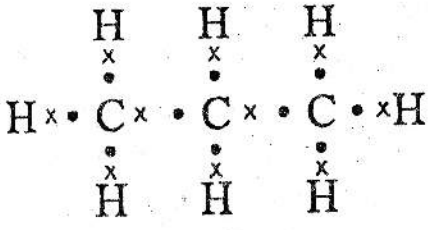
The formula that indicate the group of atoms joined together to each carbon atom in a straight chain or a branched chain is called the condensed formula.

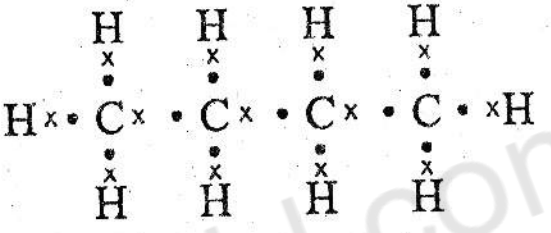
$H_3C-(CH_2)_2-CH_3$
n-butane
or
$H_3C-CH_2-CH_2-CH_3$

$H_3C-CH(CH_3)-CH_3$
isobutane

(iv) Electronic or Dot and Cross Formula

The formula which shows the sharing of electrons between various atoms in one molecule of the organic compound is called dot and cross formula or electronic formula.





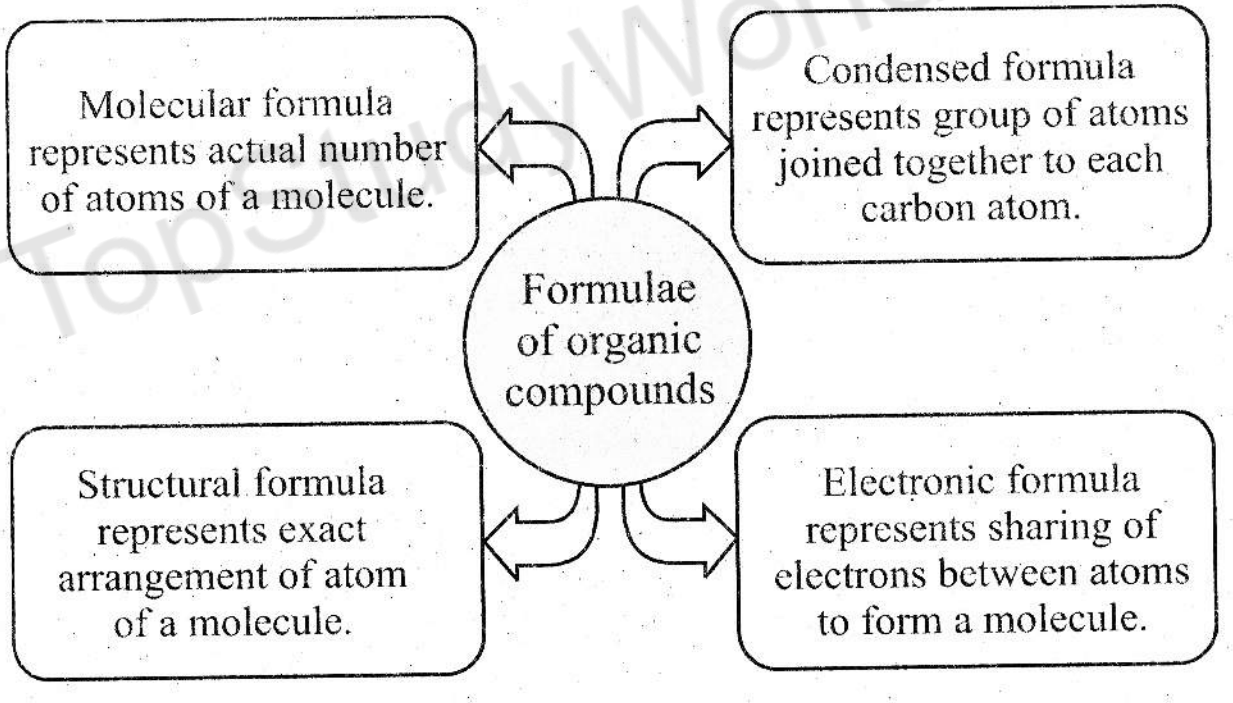


Table: presents the names, molecular formulae, condensed form and structural formulae of the first ten hydrocarbons.

Hydrocarbons

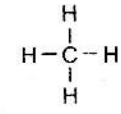
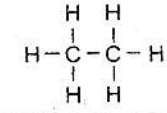
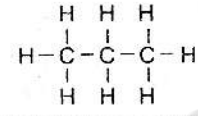
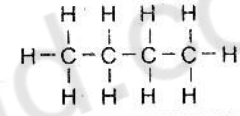
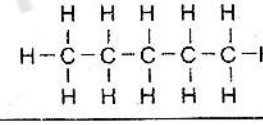
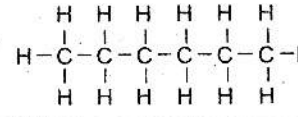
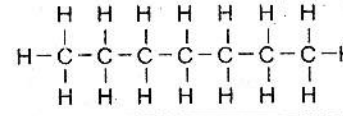
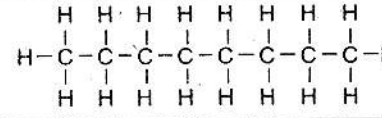
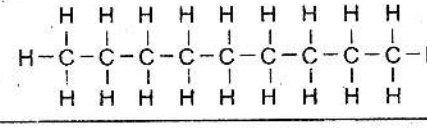
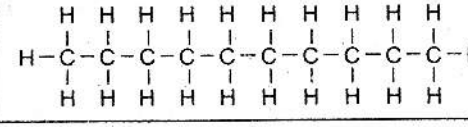
Name	Molecular Formula	Condensed Form	Structural Form
Methane	CH_4	CH_4	
Ethane	C_2H_6	H_3CCH_3	
Propane	C_3H_8	$H_3CCH_2CH_3$	
Butane	C_4H_{10}	$H_3C(CH_2)_2CH_3$	
Pentane	C_5H_{12}	$H_3C(CH_2)_3CH_3$	
Hexane	C_6H_{14}	$H_3C(CH_2)_4CH_3$	
Heptane	C_7H_{16}	$H_3C(CH_2)_5CH_3$	
Octane	C_8H_{18}	$H_3C(CH_2)_6CH_3$	
Nonane	C_9H_{20}	$H_3C(CH_2)_7CH_3$	
Decane	$C_{10}H_{22}$	$H_3C(CH_2)_8CH_3$	

Table: Names, Molecular, Condensed and Structural Formulae of Hydrocarbons

Q.2 Explain the Classification of organic compounds.

Ans. Classification of organic compounds

All known organic compounds have been broadly divided into two categories depending upon their carbon skeleton. These are:

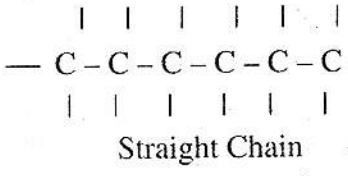
(i) Open chain or acyclic compounds.

(ii) Close chain or cyclic compounds.

(i) Open chain or Acyclic compounds

Open chain compounds are those in which the end carbon atoms are not joined with each other in this way they form a long chain of carbon atoms. These chains may be either straight or branched. For example

(a) Straight chain compounds are those in which carbon atom link with each other through a single, double or triple bonds forming a straight chain, such as

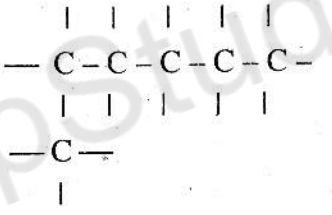


Straight Chain

$H_3C - CH_2 - CH_2 - CH_3$

Straight Chain (n-Butane)

(b) Branched chain compounds are those in which there is a branch along a straight chain, such as:



Branched chain

$H_3C - CH - CH_3$

CH_3

Branched chain (isobutane)

Open chain compounds are also called **aliphatic compounds**.

(ii) Closed chain or Cyclic compounds

Closed chain or cyclic compounds are those in which the carbon atoms at the end of the chain are not free. They are linked to form a ring. They are further divided into two classes:

(a) Homocyclic or carbocyclic compound

(b) Heterocyclic compounds.

(a) Homocyclic or carbocyclic compounds

Homocyclic or carbocyclic compounds contain rings which are made up of only one kind of atoms, i.e., carbon atoms. These are further divided into two classes:

- Aromatic compounds
- Alicyclic compounds

Aromatic compounds

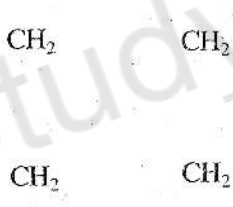
These organic compounds contain at least one benzene ring in their molecule. A benzene ring is made up of six carbon atoms with three alternating double bonds. They are called aromatic because of aroma or smell they have. For example,

Benzene Naphthalene

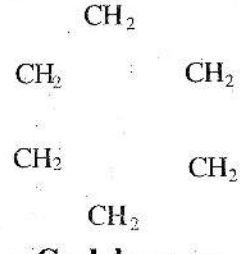
They are also called **benzenoid compounds**.

Alicyclic or non-benzenoid compounds:

Carbocyclic compounds which do not have benzene ring in their molecules are called alicyclic or non-benzenoid compounds. For examples,



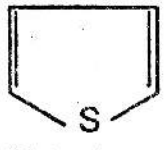
Cyclobutane



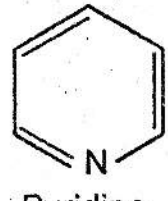
Cyclohexane

(b) Heterocyclic compounds

Cyclic compounds that contains one or more atoms other than that of carbon atoms in their rings are called heterocyclic compounds.

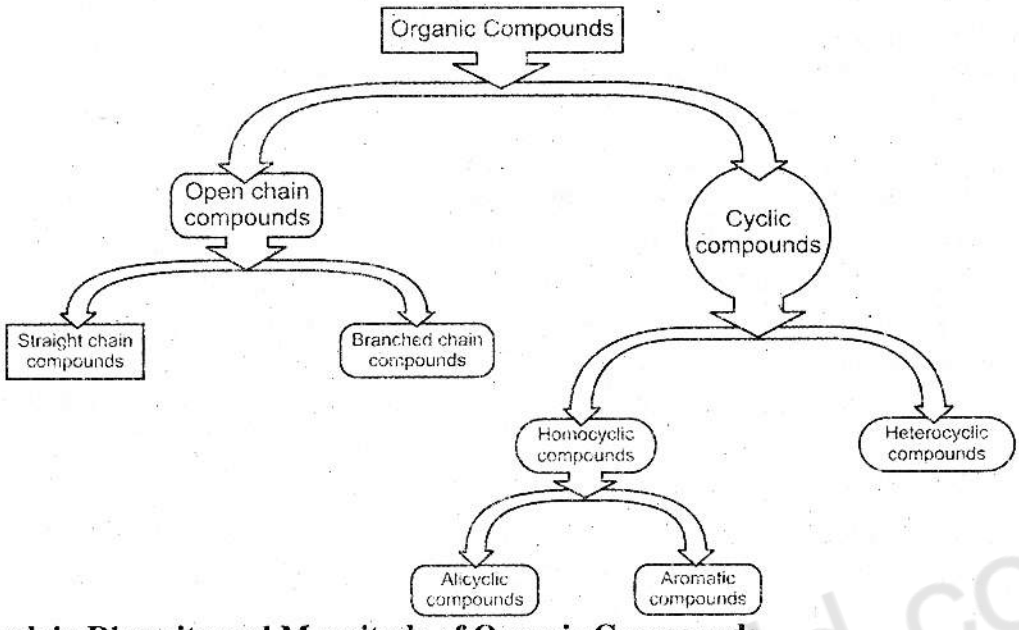


Thiophene



Pyridine

The above classification may be summarized as follows:



Q.3 Explain Diversity and Magnitude of Organic Compounds.

Ans: Diversity and Magnitude of Organic Compounds

There are a total of 118 elements known today. The number of organic compounds (carbon compounds) is more than ten million. This number is far more than the number of compounds of all the remaining elements taken together. The existence of such a large number of organic compounds is due to the following reasons:

(i) Catenation:

The main reason for the existence of a large number of organic compounds is that carbon atoms can link with one another by means of covalent bonds to form long chains or rings of carbon atoms. The chains can be straight or branched. **The ability of carbon atoms to link with other carbon atoms to form long chains and large rings is called catenation.**

Condition for Catenation

Two basic conditions for an element to exhibit catenation are:

(a) Element should have valency two or greater than two.

(b) Bonds made by an element with its own atoms should be stronger than the bonds made by the element with other atoms especially oxygen.

Silicon does not show isomerism's

Both silicon and carbon have similar electronic configurations but carbon shows catenation whereas silicon does not. It is mainly due to the reason that C-C bonds are much stronger (355 kJ mol^{-1}) than Si-Si (200 kJ mol^{-}) bonds. On the other hand, Si – O bonds are much stronger (452 kJ mol^{-1}) than C – O bonds (351 kJ mol^{-1}). Hence silicon occurs in the form of silica and silicates in nature.

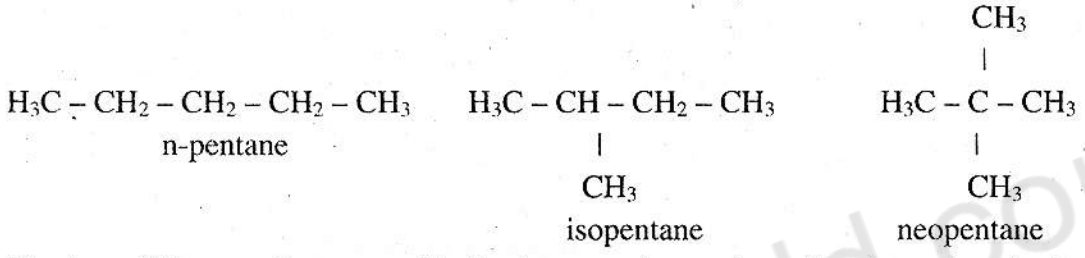
(ii) Isomerism

Another reason for the abundance of organic compounds is the phenomenon of isomerism.

Definition

The compounds are said to be isomers if they have the same molecular formula but different arrangement of atoms in molecules or different structural formulae.

Isomerism also adds to the possible number of structure. For example molecular formula of pentane C_5H_{12} can be represented by three different structures. Thus, C_5H_{12} has three isomers, as shown below:



Number of isomers increase with the increase in number of carbon atom in the given molecular formula.

iii. Strength of covalent bonds of carbon

Due to its very small size, carbon can form very strong covalent bonds with other carbon atoms, hydrogen, oxygen, nitrogen and halogens. This enables it to form a large number of compounds.

iv. Multiple bonding

In order to satisfy its tetravalency, carbon can make multiple bonds (i.e., double and triple bonds). This further adds to the possible number of structures. For example, two carbons in ethane are linked by a single covalent bond, by a double covalent bond in ethylene and a triple covalent bond in acetylene.

Q.4 Write down the general characteristic of Organic Compounds.

Ans. General characteristic of Organic Compounds

Organic compounds have the following general characteristics.

(i) Origin: Naturally occurring substances are obtained from plants and animals. On the other hand, inorganic compounds are obtained from minerals and rocks.

(ii) Composition: Carbon is an essential constituent of all organic compounds. They are made up of few elements such as carbon, hydrogen, nitrogen, oxygen, halogen, sulphur etc. On the other hand inorganic compounds are made up of almost all the elements of the Periodic Table known so far.

(iii) **Covalent linkage:** organic compound contain covalent bonds that may be polar or non-polar, while the inorganic compounds mostly contain ionic bonds.

(iv) **Solubility:** Organic compounds having non-polar linkages are generally soluble in organic solvents like alcohol, ether, benzene, carbon disulphide etc. on the other hand, the inorganic compounds with ionic bonds are soluble in polar solvents like water.

(v)**Electrical Conductivity:** Due to the presence of covalent bonds, organic compounds are poor conductor of electricity. Whereas inorganic compounds being ionic in nature, are good conductors of electricity.

(vi) **Melting and boiling points:** Generally organic compounds have low melting and boiling points and are volatile in nature. Inorganic compounds, on the other hand, have comparatively high melting and boiling points.

(vii) **Stability:** Since organic compounds have low melting and boiling points they are less stable than inorganic compounds.

(viii) **Combustibility:** Organic compounds with high percentage of carbon are generally combustible. On the other hand, inorganic compounds are mostly non-combustible.

(ix) **Isomerism:** A main characteristics of organic compounds which differentiate them from inorganic substances is their tendency to exhibit the phenomenon of isomerism. Isomerism is rare in inorganic substance.

(x)**Rate of reaction:** Due to the presence of covalent linkages, the reactions of organic compounds are molecular in nature. They are often slow and require specific conditions such as temperature, pressure or catalyst.

Q.5 How coal is formed? Explain the different types of coal.

Ans: Coal

Coal is blackish, complex mixture of compounds of carbon, hydrogen and oxygen. It also consists of small amounts of nitrogen and sulphur compounds.

Formation of coal

Coal was formed by the decomposition of dead plants buried under the Earth's crust millions of years ago. **Conversion of wood into coal is called carbonization.** It is a very slow bio-chemical process. It takes place in the absence of air under high pressure and high temperature over a long period of time (about 500 millions of years) as shown in figure. Wood contains about 40% carbon, so depending upon the extent of carbonization process, four types of coal are found. These types differ with respect to carbon content, volatile matter and moisture. Table shows the detail of contents of different types of coals and their uses in daily life and industry.

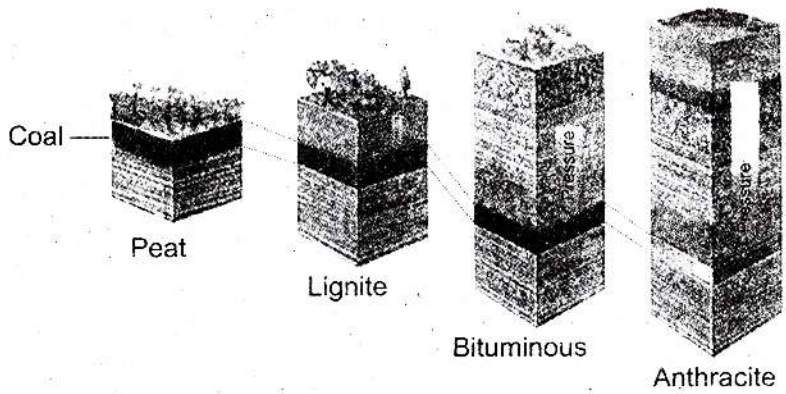


Fig. Formation of coal in different stages with the increase of pressure.

Type of Coal	Carbon contents	Uses
Peat	60%	It is inferior quality coal used in kiln.
Lignite	70%	It is soft coal used in thermal power stations.
Bituminous	80%	It is common variety of coal used as household coal.
Anthracite	90%	It is superior quality hard coal that is used in industry.

Q.6 What is destructive distillation of coal? Explain the different types of the products obtained by the destructive distillation.

Ans. Destructive distillation of Coal

Coal has become a major source of organic compounds because of destructive distillation. **The strong heating of coal in the absence of air is called destructive distillation**. As we know coal contains elements like carbon, hydrogen, oxygen, nitrogen, and sulphur. So destructive distillation of coal provides a large number of organic compounds along with a few inorganic compounds.

Products obtained by the destructive distillation of coal

(i) Coal Gas:

It is mixture of hydrogen, methane and carbon monoxide. It produces heat when burnt in air. Therefore, it is mainly used as a fuel in industry. It is also used to provide an inert or reducing atmosphere in various metallurgical processes.

(ii) Ammonical Liquor:

It is a solution of ammonia gas in water. It is used to prepare nitrogenous fertilizers. For example, when it is treated with sulphuric acid, it produces ammonium sulphate, fertilizer.

(iii) Coal-Tar:

It is a thick black liquid. It is a mixture of more than 200 different organic compounds, mostly aromatic. These compounds are separated by fractional distillation. Some of the important aromatic compounds are benzene, phenol, toluene, aniline, etc. These chemicals are used to synthesize drugs, dyes, explosives, paints, varnishes, plastics, synthetic fiber and pesticides. Besides these valuable chemicals, **the black residue of the coal tar is called pitch.** It is used for surfacing of roads and roofs.

(iv) Coke:

Coke is 98% carbon. It is left behind residue of coal. When coal is subjected to destructive distillation, it loses all its volatile components and leaves behind a solid residue called coke. It is mainly used as a reducing agent in the extraction of metals especially iron. It is also used as fuel.

Q.7 Write down the uses of organic compounds.

Ans: Uses of organic compounds

No doubt, thousands of organic compounds are synthesized naturally by animals and plants. But millions of organic compounds are being prepared in the laboratories by the chemists. Because these compounds are part of everything from food we eat to the various items we use in daily life to fulfill our needs.

(i) **Uses as Food:** The food we eat daily such as milk, eggs, meat, vegetables, etc., contain carbohydrates proteins, fats, vitamins, etc., are all organic stuff.

(ii) **Uses as Clothing:** All types of clothing (we wear, we use as bed sheets etc.) are made up of natural fibres.

(iii) **Uses as Houses:** Wood is cellulose (naturally synthesized organic compound). It is used for making house and furniture of all kinds.

(iv) **Uses as Fuel:** The fuels we use for automobiles and domestic purposes are coal, petroleum and natural gas. These are called fossil fuels. All of these are organic compounds.

(v) **Uses as medicines:** A large number of organic compounds (naturally synthesized by plants) are used as medicines by us. Most of the life saving medicines and drugs such as antibiotics (inhibit or kill microorganisms which cause infectious diseases) are synthesized in laboratories.

(vi) **Uses as Raw Material:** Organic compounds are used to prepare a variety of material, such as rubber, paper, ink, drugs, dyes, paints, varnishes, pesticides, etc.

Q.8 Define homologous series write down characteristics of homologous series.

Ans: Homologous series

Organic compounds are divided into groups of compounds having similar chemical properties. Each group is known as a homologous series. Organic compounds of the same homologous series have the following properties in common:

Characteristics of homologous series

(i) All members of a series can be represented by a general formula for example general formulae of alkane, alkenes and alkynes are CnH_{2n+2}, CnH_{2n}, and CnH_{2n-2}, respectively.

(ii) Successive members of the series differ by one unit of $-CH_2-$ and 14 units in their relative molecular mass.

(iii) They have similar chemical properties (because they contain the same functional group).

(iv) There is a regular change in their physical properties; the melting and boiling points increase gradually with the increase of molecular masses.

(v) They can be prepared by similar general methods.

Hydrocarbons are regarded as parent organic compounds. All other compounds are considered to be derived from them by substituting one or more hydrogen atoms of a hydrocarbon by one or more reactive atoms.

Q.9 Write detail note on functional groups.

Ans: Functional Group

An atom or group of atoms or presence of double or triple bound which determines the characteristic properties of an organic compound is known as the functional group. The remaining part of the molecule mainly determines the physical properties such as melting point, boiling point, density etc

Example

- OH group is the functional group of alcohols, which gives characteristics properties of alcohols. The characteristic properties of carboxylic acids are due to the presence of – COOH group in them. Therefore, functional group of carboxylic acids is – COOH group.

Functional groups containing Carbon, Hydrogen and Oxygen

The organic compounds containing carbon, hydrogen and oxygen as functional group are alcohols, ethers, aldehydes, ketones, carboxylic acids and ester. Their class name, functional group, class formula and examples are given below

(i) Alcoholic Group

The functional group of alcohols is – OH. Their general formula is ROH. Where R is any alkyl group.

$CH_3 - OH$	$CH_3 - CH_2 - OH$	$CH_3 - CH_2 - CH_2 - OH$
Methyl alcohol	Ethyl Alcohol	n-Propyl alcohol

(ii) Ether Linkage

The functional group of ether is C – O – C. their general formula is

R-O-R′. where R and R′ are alkyl groups

R and R may be same or different, such as

H_3C-O-CH_3 Dimethyl ether

C_2H_5-O-C_2H_5 Diethyl ether

H_3C-O-C_2H_5 Ethyl methyl ether

(iii) Aldehydic Group

Aldehyde family consists of functional group $-\overset{\overset{O}{\|}}{C}-H$

Their general formula is RCHO.

Where R stands for H or some alkyl group, such as:

$H-\overset{\overset{O}{\|}}{C}-H$	$H_3C-\overset{\overset{O}{\|}}{C}-H$
Formaldehyde	Acetaldehyde

(iv) Ketonic Group

Compounds containing the functional group $\diagdown C{=}O \diagup$ are called ketones.

They have the general formula $R-\overset{\overset{O}{\|}}{C}-R'$

Where R and R′ are alkyl groups. They may be same or different, such as:

$H_3C-\overset{\overset{O}{\|}}{C}-CH_3$	$H_3C-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$
Acetone (Dimethyl Ketone)	EthylmethylKetone

(v) Carboxyl Group

Compounds containing functional group $-\overset{\overset{O}{\|}}{C}-OH$ are called carboxylic acids. their general formula is $R-\overset{\overset{O}{\|}}{C}-OH$;

Where R stands for – H or some alkyl group. Such as:

$H-\overset{\overset{O}{\|}}{C}-OH$ Formic acid

$H_3C-\overset{\overset{O}{\|}}{C}-OH$ Acetic acid

vi) Ester Linkage

compound containing functional group $R-\overset{\overset{O}{\|}}{C}-OR'$ are called ester linkage and their general formula is $R-\overset{\overset{O}{\|}}{C}-OR'$.

Example:

$H_3C-\overset{\overset{O}{\|}}{C}-OCH_3$
Methyl Acetate

Q.10 Write the note on the followings (i) Petroleum (ii) Natural gas

Ans. Petroleum

Petroleum is a dark brownish or greenish black coloured viscous liquid. It is a complex mixture of several solid, liquid or gaseous hydrocarbons mixed with water, salt and earth particles.

Petroleum is a main source of organic compounds. It consists of several compounds mainly hydrocarbons. These compounds are separated by

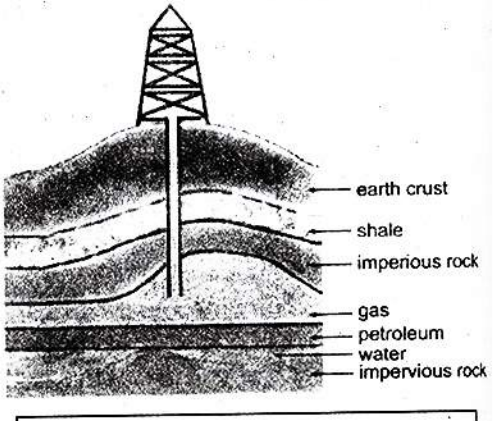


Fig: Occurrence and drilling of gas

fractional distillation (separation of fractions or components depending upon their boiling point ranges). Each fraction is not a single compound; rather each of it consists of different organic compounds.

Natural Gas

It is a mixture of low molecular mass hydrocarbons. The main component about 85% is methane, along with other gases ethane, propane and butane. Its origin is similar to that of coal and petroleum. Therefore, it is found with their deposits as shown in figure. Natural gas is used as fuel in homes as well as in industries. It is used as fuel in auto-mobiles as compressed natural gas (CNG). Natural gas is also used to make carbon black and fertilizer.

Q.11 Explain the formation of Alkyl radical.

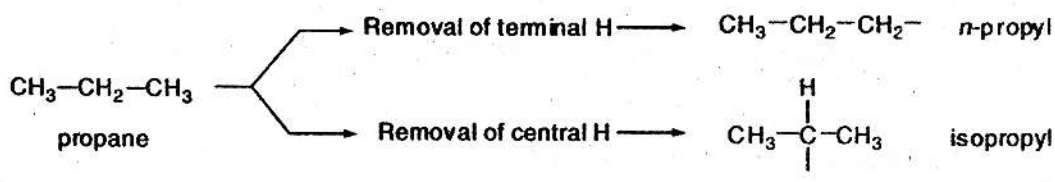
Ans: Formation of Alkyl Radicals

Alkyl radicals are derivatives of alkanes. They are formed by the removal of one of the hydrogen atom of an alkane and are represented by a letter 'R'. their name is written by replacing 'ane' of alkane with 'yl'. Table represents first ten alkanes and their alkyl radicals. Their general formula is C_nH_{2n+1}.

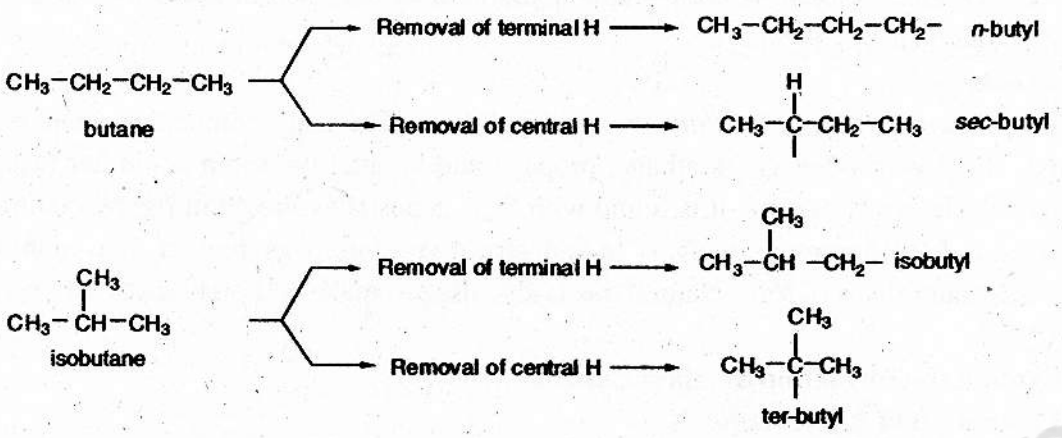
Table: Names and Molecular Formulae of Alkanes and their Alkyl Radicals

Alkane	Molecular Formula	Alky radical	Name
Methane	CH_4	CH_3 ---	Methyl
Ethane	C_2H_6	C_2H_5 ---	Ethyl
Propane	C_3H_8	C_3H_7 ---	Propyl
Butane	C_4H_{10}	C_4H_9 ---	Butyl
Pentane	C_5H_{12}	C_5H_{11} ---	Pentyl
Hexane	C_6H_{14}	C_6H_{13} ---	Hexyl
Heptane	C_7H_{16}	C_7H_{15} ---	Heptyl
Octane	C_8H_{18}	C_8H_{17} ---	Octyl
Nonane	C_9H_{20}	C_9H_{19} ---	Nonyl
Decane	$C_{10}H_{22}$	$C_{10}H_{21}$ ---	Decyl

It is better to explain the type of radicals of propane and butane. Propane has a straight chain structure. When terminal H is removed it is called ***n – propyl***. When hydrogen from central carbon is removed it is called ***isopropyl,*** as explained below:



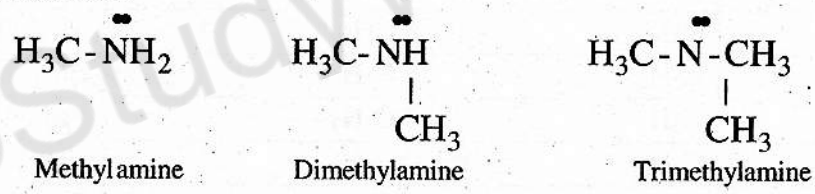
Similarly, different structures of butyl radicals are explained:



Q.12 Explain functional group containing carbon, hydrogen and Nitrogen.

Ans: Functional Group Containing Carbon, Hydrogen and Nitrogen:

The organic compounds containing carbon, hydrogen and nitrogen as functional group are called as amines. Their functional group is $-NH_2$, and their general formula is $R\text{-}NH_2$. Examples of amines are:



Functional Group Containing Carbon, Hydrogen and Halogens:

The organic compounds having functional group containing carbon, hydrogen and halogens are called alkyl halides. Their functional group is R-X. 'X' may be F, Cl, Br or I.

Table Functional group containing carbon, hydrogen and halogens

Class Name	Functional Group	Class Formula	Examples
Alkyl Halides			
a. Primary	$-CH_2-X$	$R-CH_2-X$	H_3C-CH_2-X Ethyl halide
b. Secondary	$\rangle CH-X$	R_2CH-X	$(H_3C)_2CH-X$, *sec*-Propyl halide
c. Tertiary	$-\overset{\vert}{\underset{\vert}{C}}-X$	R_3C-X	$(H_3C)_3C-X$ *ter*-Butyl halide

Double and Triple Bond:

Organic compounds consisting of double bonds in their molecules are called as alkenes, such as:

$H_2C = CH_2$ Ethene $\qquad$ $H_3C - CH = CH_2$ Propene

Organic compounds consisting of triple bonds in their molecules are called as alkynes, such as:

$HC \equiv CH$ Ethyne $\qquad$ $H_3C - C \equiv CH$ Propyne

Q. 13 Explain the tests of functional groups?

Ans: Tests of functional groups

Test for Unsaturation $>C = C<$ **or** $-C \equiv C-$

i. Bromine water test:

Dissolve a pinch of the given organic compound in 2.0 cm^3 of carbon tetrachloride(CCl_4). Add 2 cm^3 of bromine water in it and shake.

Result: Bromine will be decolourised.

ii. Baeyer's test:

Dissolve about 0.2 g of the organic compound in water. Add to it 2-3 drops of alkaline $KMnO_4$ solution and shake.

Result: Pink colour will disappear.

Test for Alcoholic Group - OH

i. Sodium metal test:

Take about 2-3 cm^3 of the given organic liquid in a dry test tube and add a piece of sodium metal.

Result: Hydrogen gas will evolve.

ii. Ester formation test

Heat about 1.0 cm^3 of the organic compound with 1.0 cm^3 of acetic acid and 1 – 2 drops of concentrated sulphuric acid.

Result: Fruity smell will be given out

Test for Carboxylic Group $-\overset{\overset{O}{\|}}{C}-OH$

i. Litmus test:

Shake a pinch of the given compound with water and add a drop of blue litmus solution.

Result: Litmus paper will turn red.

ii. $NaHCO_3$ solution test:

Take about 2.0 cm^3 of 5% $NaHCO_3$ solution and add a pinch of given compound.

Result: CO_2 gas with effervescence evolves.

Detection of Aldehydic Group $-\overset{\overset{O}{\|}}{C}-H$

i. Sodium bisulphite test

Shake about 0.2 g or 0.5 cm^3 of the given compound with 1-2 cm^3 of saturated solution of sodium bisulphate.

Result: A crystalline white precipitate will be formed.

ii. Fehling's solution test:

Mix equal volumes of Fehling's solution A and B in a test tube. Add a pinch of organic compound and boil for five minutes.

Result: Red precipitate will be formed.

Test for ketonic Group

i. Phenyl hydrazine test:

Shake a pinch of the given organic compound with about 2.0 cm^3 of phenyl hydrazine solution.

Result: Orange red precipitate will be formed.

ii. Sodium nitroprusside test:

Take about 2.0 cm^3 of sodium nitroprusside solution in a test tube and add 2-3 drops of NaOH solution. Now add a pinch of the given compound and shake.

Result: Red colour will be formed.

iii. With Fehling's solution:

No reaction

Test for Primary Amino Group ($-NH_2$)

Carbyl amine test:

Heat about 0.2 g of the given compound and add 0.5 cm^3 of chloroform and add 2-3 cm^3 of alcoholic KOH.

Result: Extremely unpleasant odour will be given out.

Test of Ester:

They are recognized by their fruity smell.

Short Answer Questions

Q.1 What is vital force theory who proposed it?

Ans: According to vital force theory organic compounds could not be prepared in laboratories because they were supposed to be synthesized under the influence of a mysterious force called vital force inherent only in living things

In early 19th century Swedish chemist Jacob Berzellius proposed this theory.

Q.2 Who rejected the vital force theory and how?

Ans: Vital force theory was rejected by Wohler in 1828 when he synthesized the first organic compound urea from inorganic substance by heating ammonium cyanate (NH_4CNO)

$$NH_4CNO \xrightarrow{\Delta} H_2N - \underset{\underset{\text{Urea}}{\|}}{\overset{\overset{O}{\|}}{C}} - NH_2$$

Q.3 Define organic chemistry.

Ans: The branch of chemistry which deals with the study of hydrocarbons and their derivatives is known as organic chemistry".

Q.4 What are different types of formula by which we can represent organic compounds?

Ans: Organic compounds can be represented by following four types of formula.

a) Molecular formula. b) Structural formula

c) Condensed formula d) dot and cross formula.

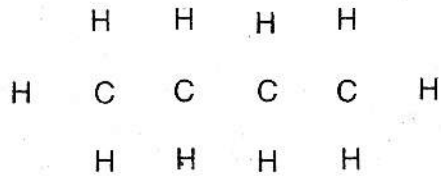
Q.5 Define molecular formula.

Ans: The formula which represents the actual number of atoms in one molecule of the organic compound is called molecular formula. For example molecular formula of butane is C_4H_{10}.

Q.6 Define structural formula.

Ans: Structural formula of a compound represents the exact arrangement of the different atoms of various elements present in molecule of a substance.

Structural formula of butane is



(n - butane)

Q.7 Define condensed formula.

Ans: The short form of formula that indicates the group to each carbon atom in a straight chain or branched chain is called a condensed formula.

For example condensed formula for n – butane is

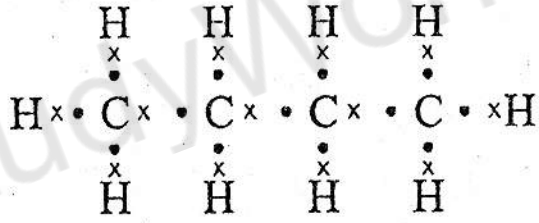
⇨ $CH_3 - CH_2 - CH_2 - CH_3$

OR ⇨ $CH_3 - (CH_2)_2 - CH_3$

Q.8 What is dot and cross formula.

Ans: "The formula which shows the sharing of electrons between various atoms of one molecule of the organic compound is called dot cross formula or electronic formula".

For example: cross and dot formula for butane is



Q.9 Write down the names of classes in which organic compounds are classified.

Ans: All organic compounds are broadly classified into two classes.

a) Open chain or Acyclic compound:

b) Closed chain or Cyclic compound:

Q.10 Define open chain compound. Explain their types.

Ans: Open chain compounds are those in which the end carbon atoms are not joined with each other in this way they form long chain of carbon atoms.

There are two types of open chain compound

a) Straight chain compounds.

b) Branched chain compounds:

a) Straight chain compounds.

Compounds in which carbon atoms link with each other through a single, double or triple bonds forming a straight chain.

For example $H_3C - CH_2 - CH_2 - CH_3$

(Straight chain butane)

b) Branched chain compounds.

"compounds in which there is a branch along a straight chain".

For example:

$$H_3C - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_3$$

(Branched chain) (Iso–butane)

Q.11 What are aliphatic compounds?

Ans: Open chain compounds in which only single bond is present are also called aliphatic compounds.

Q.12 Define cyclic compounds explain their types.

Ans: Those compounds in which the carbon atoms at the ends are not free and they join to form rings.

They are further divided into two classes.

a) Homocyclic compound b) Heterocyclic compound

Q.13 Define Homocyclic compounds. Explain their types.

Ans: Compounds contain rings which are made up of only one kind of atoms, i.e, carbon atoms are called Homocyclic compounds.

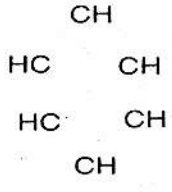
There are two types of Homocyclic compounds.

a) Aromatic compounds **b)** Alicyclic compounds

Q.14 Define aromatic compound. Give example.

Ans: "Those homocyclic compounds in which at least one benzene ring having six carbon atoms with three alternate double and single bonds are called aromatic compound".

Example benzene ring.



Q.15 What is the meaning of term aromatic?

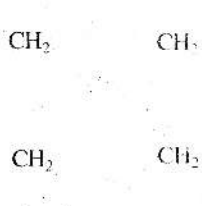
Ans: Term aromatic is derived from Greek word "Aroma" which means fragrant".

Q.16 What are benzenoid compounds?

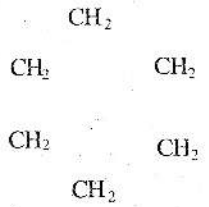
Ans: Aromatic compounds are also called benzenoid compounds.

Q.17 Define alicyclic or non benzenoid Compounds.

Ans: Carbocyclic or homocyclic compound which do not have benzene ring in their molecules are called alicyclie or non benzenoid compounds.



Cyclobutane



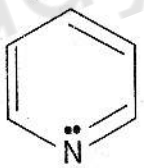
Cylohexane

Q.18 Define Heterocyclic compound. Give example.

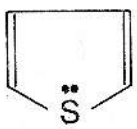
Ans: Cyclic compounds that contain one or more atoms other than carbon atoms in their rings are called heterocyclic compounds.

For examples:

Pyridine



Thiophene



Q.19 Define catenation.

Ans: The ability of carbon atoms to link with other carbon atoms to form long chains and large rings is called catenation.

Q.20 What are two basic conditions for elements to exhibit catenation?

Ans: Two basic conditions for catenation are:

a) Element should have valency two or more greater than two.

b) Bond made by an element with its own atoms should be stronger than the bonds made by the element with other atoms especially oxygen.

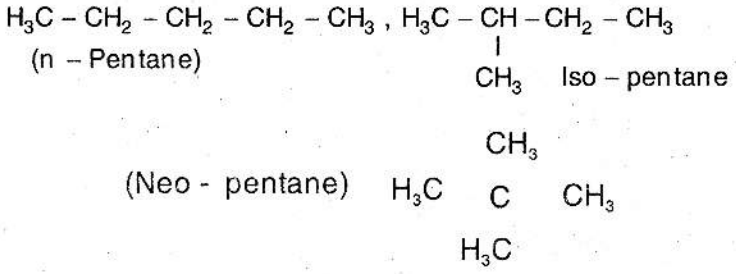
Q.21 Define Isomerism. Give examples.

Ans: Isomerism

The compounds having same molecular formulae but different arrangement of atoms in their molecules or different structural formulae are called isomers and the phenomenon is

called Isomerism.

e.g. pentane (C_5H_{12}) has three isomers



Q.22 Why and how carbon complete its octet?

Ans: To get stability, carbon completes its octet by making four covalent bond with other atoms.

Q.23 Why melting and boiling points and of organic compounds are very low?

Ans: Melting points and boiling point of organic compounds are low because carbon forms weak covalent bond with other carbon atoms which break up easily.

Q.24 Why organic compounds are poor conductor of electricity?

Ans: Due to presence of covalent bonds, organic compounds are poor conductor of electricity.

Q.25 How we get organic compounds from Earth's crust?

Ans: We get organic compounds by Destructive distillation of coal and by Fractional distillation of Petroleum.

Q.26 What are the reasons for the formation of millions of organic compounds?

Ans: Organic compounds have large diversity due to

a) catenation b) isomerism c) weak covalent bond

d) Multiple bonds forming ability of carbon.

Q.27 What is coal?

Ans: Coal is blackish, complex mixture of compounds of carbon, hydrogen and oxygen. It also consists of small amount of nitrogen and sulphur compounds.

Q.28 Define Carbonization.

Ans: Conversion of wood into coal is called carbonization. It is very slow bio-chemical process. It takes place in the absence of air under high pressure and high temperature over a long period of time.

Q.29 Write down the names of different types of coal.

Ans: Coal is of following four types.

a) Peat b) lignite c) Bituminous d) anthracite

Q.30 Define Destructive Distillation?

Ans: Breakdown of coal into smaller compounds by strong heating of coal in the absence of air is called destructive distillation.

Q.31 Write down the names of product obtained by destructive distillation of coal.

Ans: Products obtained by destructive distillation of coal are;

a) Coal Gas b) Ammonical Liquor c) Coal tar d) coke

Q.32 What is Pitch? What is its use?

Ans: Black residue of coal tar is called Pitch. In common words it is also known as "look". It is used for surfacing of roads and roofs.

Q.33 What is petroleum? What is its composition?

Ans: Petroleum is a dark brownish or greenish black coloured viscous liquid. It is a complex mixture of several solid, liquid or gaseous hydrocarbons in water mixed with salts and earth particles.

Q.34 What is composition of natural gas?

Ans: Natural gas is a mixture of low molecular mass hydrocarbons. The main component about 85% is methane, along with other gases i.e. ethane, butane, propane.

Q.35 What types of compounds are synthesized by plants?

Ans: Living plants synthesized macro-molecule e.g. carbohydrates, proteins, oils and vitamins plants also produce gums, rubber, medicines etc.

Q.36 What are alkanes? Give their general formula?

Ans: Alkanes are saturated hydrocarbons or paraffin's (Para - little , affines – affinity). Their general formula is C_nH_{2n+2}. Where n is the number of carbon atoms.

Q.37 Define alkyl radical. How they formed?

Ans: Alkyl Radicals are derivatives of alkanes they are formed by removal of one of the hydrogen atom of an alkane and are represented by "R.". Their general formula is C_nH_{2n+1}

Q.38 What is Functional group? Give example.

Ans: "An atom or group of atom or presence of double or triple bond which determines the characteristics properties of an organic compound is known as the functional group".

For example - OH – hydroxyl group is the functional group of alcohol which give characteristic properties of alcohols.

Q.39 What is functional group for aldehyde and ketone?

Ans: Functional groups for aldehyde and ketone are

$$(-\overset{\overset{O}{||}}{C}-H) \text{ and for ketone is } (-\overset{\overset{O}{||}}{C}-R)$$

Q.40 What is functional group for ether and carboxylic compounds?

Ans: Functional group for ether is (R – O – R) and for carboxylic compound is $(R-\overset{\overset{O}{||}}{C}-OH)$

Q.41 What is ester linkage?

Ans: Organic compounds in which carbon has $R-\overset{\overset{O}{||}}{C}-OR'$ linkage is called ester linkage.

These compounds are called esters.

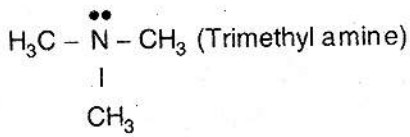
Q.42 What are amines give examples?

Ans: "The organic compounds containing carbon, hydrogen and nitrogen as a functional group ($-NH_2$) are called amines. ($-NH_2$) is functional group and their general formula is $R-NH_2$.

Examples:

$H_3C-\ddot{N}H_2$ (Methyl amine)

$H_3C-\ddot{N}H-CH_3$ (Dimethyl amine)



$H_3C - \ddot{N} - CH_3$ (Trimethyl amine)

CH_3

Q.43 What is functional group for an alkyl Halide?

Ans: Functional group for alkyl halide is R – X where R is alkyl radical and X is halogen i.e. F, Cl, Br or I., etc.

Q.44 Give functional group for alkene and alkyne.

Ans: For alkene double bond (=) is functional group and triple bond (≡) is functional group for alkyne.

e.g. $H_2C = CH_2$ (ethene)

$HC \equiv CH$ (ethyne)

Q.45 Write down the name of tests for detection of double bond (unsaturation)?

Ans: i) Bromine water test **and**

ii) Baeyer's test is used to detect unsaturation.

Q.46 What are identification test for alcoholic group?

Ans: i) sodium metal test and

ii) Ester formation test is used to test alcoholic group.

Q.47 How carboxylic group is identified?

Ans: Carboxylic group is identified by

i) Litmus test

ii) Sodium bicarbonate test.

Q.48 Give identification test for aldehyde group?

Ans: Aldehydes are identified by

i) Sodium bisulphate test

ii) Fehling's solution Test

Q.49 What are identification test for ketonic group?

Ans: ketone group is identified by

i. Phenyl hydrazine Test

ii. Sodium Nitroprusside Test

iii. Fehling Solution Test

Q.50 Write down the name of identification test for primary Amines?

Ans: Carbyl amine test is use to identify primary amine group.

Q51. Point out the properties of carbon which are responsible for formation of long chains of carbon atom compounds?

Ans: Catenation is the process which is responsible for formation of long chains of carbon atom compounds.

Q.52 Name the gases which are found in coal gas.

Ans: Carbon monoxide hydrogen and methane gases are present in coal gas.

Q.53 Is coal tar a compound? What is importance of coal tar?

Ans: No it is a mixure of more than 200 different organic compounds, mostly chromatic. The importance of coal tar is, the compounds obtained from coal tar are used to synthesize drugs, dyes. Paints, explosives, varnishes, plastics, synthetic fibre and pesticides.

Q.54 What is coke? For what purpose it is used?

Ans: When coal is subjected to destructive distillation it loses all its volatile components and leaves behind solid residue called coal. It is used as a reducing agent in the extraction of metal especially iron. It is also used as fuel.

Q.55 Which is the best quality of coal?

Ans: Anthracite is the best quality of coal. It contains 90% of carbon.

Q.56 What is destructive distillation?

Ans: The strong heating of coal in the absence of air is called destructive distillation

Q.57 Define petroleum.

Ans: Petroleum is a dark brownish or greenish black coloured viscous liquid. It is a complex mixture of several solid, liquid or gaseous hydrocarbons in water mixed with salts and earth particles.

Q.58 What types of compounds are synthesized by plants?

Ans: Living plants synthesized macro-molecules e.g. carbohydrates, proteins, oils and vitamins.

Q.59 What is the basic unit of carbohydrates and how it is synthesized?

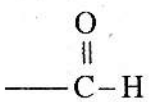
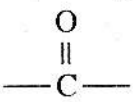
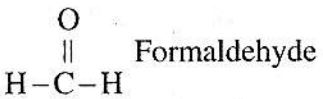
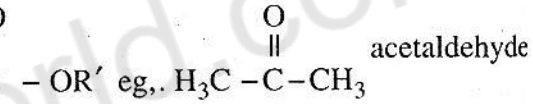
Ans: The basic unit of all carbohydrates is glucose which is synthesized by plant through photosynthesis.

Q.60 CNG stands for.

Ans: CNG stands for compressed natural gas.

Q.61 What is the difference between aldehyde and ketones?

Ans:

Aldehydes	Ketenes
i. Aldehyde family consists of functional group 	i. Ketone family consist of functional group 
ii. Their general formula is RCHO eg  Formaldehyde	ii. Their general formula is  acetaldehyde

Q62. What is the importance of natural gas?

Ans: The importance of natural gas are

i. Natural gas is used as fuel in homes as well as in industries.

ii. It is used as fuel in automobiles as compressed natural gas (CNG).

iii. Natural gas is also used to make carbon black and fertilizer.

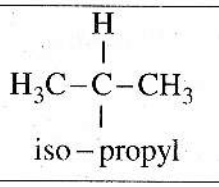
Q63. Justify that organic compounds are used as food.

Ans: The food we eat daily such as milk, eggs, meats, vegetables, etc, contain carbohydrates proteins, fats, vitamins etc are all organic stuff.

Q64. What is the difference between n-propyl and isopropyl? explain with structure.

Ans:

n-propyl	Iso-propyl
When terminal hydrogen is removed from propane it is called n-propyl e.g. $CH_3 - CH_2 - CH_2 -$ n–propyl	When hydrogen is removed from central carbon is called iso-propyl e.g.

Multiple Choice Questions

1. The ability of carbon atoms to form chains is called

(a) isomerism (b) catenation
(c) resonance (d) condensation

2. Coal having 90% carbon contents is called

(a) peat (b) lignite
(c) anthracite (d) bituminous

3. Main component of natural gas is

(a) methane (b) propane
(c) butane (d) propene

4. The strong heating of coal in retorts in the absence of air is called

(a) fractional distillation
(b) sublimation
(c) roasting
(d) destructive distillation

5. Pitch is black residue of

(a) coke (b) coal-tar
(c) coal (d) coal gas

6. Natural gas is 85% methane. It is used to make the following except

(a) carbon black (b) ethane
(c) propane (d) coal gas

7. Which one of the following does not contain starch

(a) sugar cane (b) maize
(c) barley (d) potatoes

8. Petroleum is refined by

(a) destructive distillation
(b) fractional distillation
(c) simple distillation
(d) dry distillation

9. In laboratory urea was prepared by

(a) Wohler (b) Rutherford
(c) Berzelius (d) Dalton

10. General formula of alkyl radical is

(a) $C_nH_{2\ n+2}$ (b) $C_nH_{2\ n-2}$
(c) $C_nH_{2\ n+1}$ (d) C_nH_{2n}

11. Identify which one of the following compounds is a ketone?

(a) $(CH3)_2$ CHOH
(b) $(CH_3)_2CHCl$
(c) $(CH_3)_2CO$
(d) $(CH_3)_2CHCl$

12. The functional group – COOH is found in

(a) carboxylic acid
(b) aldehydes
(c) alcohols
(d) esters

13. Which one of the following statements is not true about fossil fuels?

(a) they all contain carbon
(b) they are renewable
(c) they produce pollutants when burnt
(d) they cause acid rain

14. Which one of the following is the hardest coal?

(a) peat (b) lignite
(c) bituminous (d) anthracite

15. In which of the following groups, oxygen is attached on both sides with carbon atoms?

(a) ketone (b) ether
(c) aldehyde (d) ester

16. Carbonization process is the conversion of

(a) coal into coal gas
(b) coal into wood
(c) wood into coal
(d) wood into coal tar

17. Coal gas is a mixture of

(a) CO and CH_4
(b) CO, CH_4, CO_2
(c) CO, CH_4, H_2
(d) CO, H_2 and CO_2

18. Which one of the following is a synthetic fibre?

(a) cotton (b) wool
(c) nylon (d) silk

19. Which one of the following is not a fossil fuel?

(a) coal (b) natural gas
(c) biogas (d) petroleum

20. Which one of the following does not contain protein

(a) pulses (b) potatoes
(c) beans (d) eggs

21. Conversion of dead plants into coal by the action of bacteria and heat is called

(a) carbonization (b) catenation
(c) hydrogenation (d) cracking

22. Which one of the following compounds is an aldehyde?

(a) $CH_3 - CH_2 - OH$
(b) $CH_3 - COOH$
(c) CH_3CHO
(d) CH_3COCH_3

23. Formula of acetaldehyde is

(a) $CH - CH_2\,OH$

(b) $CH_3 - \overset{\overset{O}{\|}}{C} - OH$

(c) $CH_3 - \overset{\overset{O}{\|}}{C} - H$

(d) $H - \overset{\overset{O}{\|}}{C} - H$

24. Who put forward the vital force theory?

(a) Berzelius (b) Wohler
(c) Dalton (d) Lavoisier

25. Who was discarded vital force theory?

(a) Berzelius (b) Wohler
(c) Dalton (d) Lavoisier

26. The 1st organic compound prepared in laboratory

(a) Sodium Chloride
(b) Urea
(c) thiourea (d) Pyridine

27. Who was prepared acetic acid in laboratory?
(a) Berzelius (b) Wohler
(c) Kolbe (d) Dalton

28. The branch of chemistry which deals with the study of hydrocarbons and their derivatives is known as
(a) Organic chemistry
(b) Inorganic chemistry
(c) Biochemistry
(d) Nuclear Chemistry

29. The formula which represents the actual number of atoms in one molecule of organic compound is called
(a) Molecular formula
(b) Structural formula
(c) Condensed formula
(d) Dot and cross formula

30. Molecular formula of butane is
(a) C_4H_{10} (b) C_5H_5
(c) C_4H_8 (d) C_4H_6

31. Which of the following formula of a compound represents the exact arrangement of the different atoms of various elements present in a molecule of a substance?
(a) Molecular formula
(b) Structural formula
(c) Condensed formula
(d) Dot and cross formula

32.Which one is homocyclic compound?
(a) Benzene (b) Cyclobutane
(c) Cyclohexane (d) All

33. Which one is hetrocyclic compound?
(a) Benzene (b) Cyclobutane
(c) Thiophene (d) Naphthalene

34. Silicon occurs in the form of
(a) Silica (b) Silicates
(c) both a & b (d) None

35. Which one contains double covalent bond?
(a) Pentane (b) ethylene
(c) acetylene (d) all

36. Which one contains triple covalent bond?
(a) Pentane (b) ethylene
(c) acetylene (d) all

37. Coal is blackish complex mixture of compounds of
(a) Carbon (b) hydrogen
(c) oxygen (d) all

38. Conversion of wood into coal is called
(a) Carbonization
(b) destructive distillation
(c) fractional distillation
(d) all

39. The % age of carbon in coal is
(a) 40-60 (b) 50-70
(c) 40-80 (d) 40-90

40. The % age of carbon in peat is
(a) 60% (b) 70%
(c) 80% (d) 90%

41. The % age of carbon is lignite is
(a) 60 (b) 70
(c) 80 (d) 90

42. The % age of carbon in bituminous is
(a) 60 (b) 70
(c) 80 (d) 90

43. The strong heating of coal in the absence of air is called

(a) Carbonization
(b) Destructive distillation
(c) Fractional distillation (d) All

44. Coal gas is the mixture of

(a) hydrogen (b) methane
(c) Carbon monoxide (d) all

45. Coal tar contains compounds

(a) benzene (b) phenol
(c) toluene (d) all

46. The % age of carbon in coke is

(a) 60 (b) 70
(c) 90 (d) 98

47. Natural gas contains

(a) methane (b) ethane
(c) propane (d) all

48. The general formula of alkane is

(a) CnH_{2n+2} (b) CnH_{2n-2}
(c) CnH_{2n} (d) CnH_{2n+1}

49. Alkyl radical is derivative of

(a) alkane (b) alkene
(c) alkyne (d) all

50. The functional group of alcohol is

(a) –OH (b) -X
(c) $-\overset{\overset{O}{\|}}{C}-H$ (d) $-\overset{\overset{O}{\|}}{C}-OH$

51. Aldehyde family consists of functional group

(a) –OH (b) -X
(c) $-\overset{\overset{O}{\|}}{C}-H$ (d) $-\overset{\overset{O}{\|}}{C}-OH$

52. Ketonic group contains the functional group

(a) –OH (b) -X
(c) $-\overset{\overset{O}{\|}}{C}-$ (d) $-\overset{\overset{O}{\|}}{C}-OH$

53. Carboxylic group contains functional

(a) –OH (b) -X
(c) $-\overset{\overset{O}{\|}}{C}-H$ (d) $-\overset{\overset{O}{\|}}{C}-OH$

Answer Key

1	b	2	c	3	a	4	d	5	b
6	b,c	7	a	8	b	9	a	10	c
11	c	12	a	13	d	14	d	15	b
16	c	17	c	18	c	19	c	20	b
21	a	22	c	23	c	24	a	25	b
26	b	27	c	28	a	29	a	30	a
31	b	32	d	33	c	34	c	35	b
36	c	37	d	38	a	39	d	40	a
41	b	42	c	43	b	44	d	45	d
46	d	47	d	48	a	49	a	50	a
51	c	52	c	53	d				